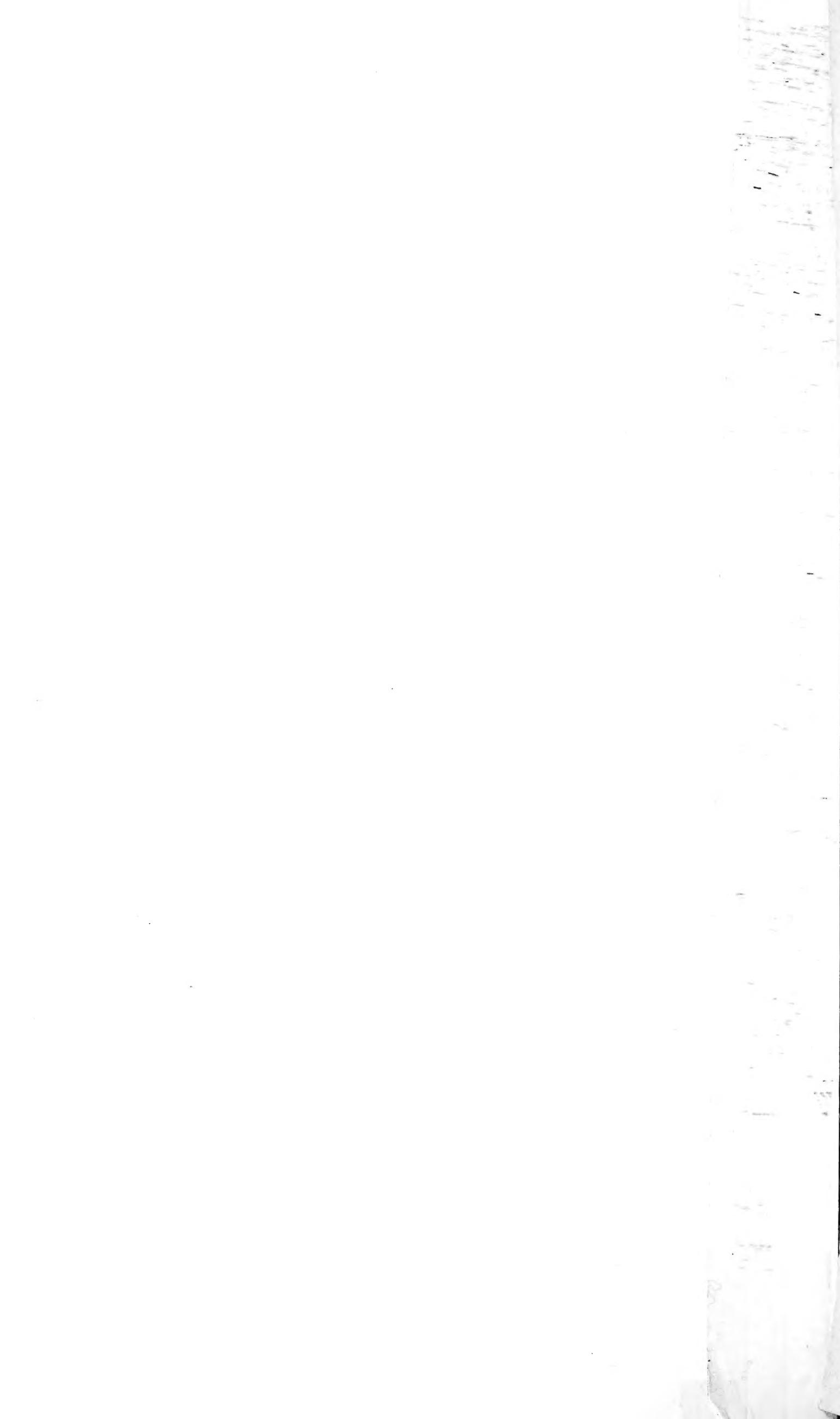


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*G. B. Hartley.*

# **SWEET CLOVER**

**AND**

## **HOW TO GROW IT**

**BY**

**E. E. BARTON**

Member  
American Breeders Association

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## **PREFACE.**

The first edition of this pamphlet was issued in February, 1911, and being limited in number, was soon exhausted. The second edition was revised and rewritten and issued in much larger numbers early in January, 1912, but was practically exhausted in six months, indicating an increasing interest among farmers and landowners in the subject of sweet clover. A large number of requests from foreign countries for copies indicate a world-wide interest in economical forage and soil-building leguminous plants. Many favorable comments on the pamphlet have come to the author's notice, both in correspondence and through the agricultural press, and he takes this opportunity to express his gratitude and appreciation. If by this means there is added some little to the interest taken in the value and importance of forage plants and soil fertility and maintenance, he will feel amply compensated for recording here his observations and experiences in growing Sweet Clover. The present edition gives to its readers the benefit of the latest researches on the subject of Sweet Clover and its cultivation.

**THE AUTHOR.**

Falmouth, Ky., November, 1912.

# SWEET CLOVER.

## INTRODUCTION.

The object of this pamphlet is to present the subject of Sweet Clover in a plain, practical way, and omitting technical and scientific terms, is addressed in plain language to our farmers and landowners who are interested in hay and pasturage, and in restoring the fertility of the soil and maintaining it in a condition to supply the increasing wants of man and the domestic animals.

It is intended to convey some information and a few useful suggestions on a subject about which until quite recently, there has been very little written of an authoritative character, and about which there is some confusion, a little prejudice, and much misinformation. Much could be written here on forage crops, seed, sowing, soils and their preparation for sowing, but it is desired to keep within the limits of a few pages only.

What is said about growing Sweet Clover applies to the white and the biennial yellow kinds, which are the only ones that will concern the practical farmer, and to conditions of climate, etc., existing in Pendleton County (in Northern Kentucky), where the author has had much experience and success for a number of years in growing these varieties. Sowing seed north or south of here should be timed to suit the differences in temperature and season.

## DESCRIPTION.

Sweet Clover, as with red clover, alfalfa, the beans, peas and numerous other kindred species, belongs to the family of plants called legumes, a group of plants whose importance to agriculture is beginning to be recognized more and more the world over, and furnishes, in a large measure, the food supply of both man and beast, as well as constituting the mainstay of the soil's fertility.

Although Sweet Clover is called a clover, it is not strictly such, it and alfalfa and the clovers being classed as separate and distinct branches of the legume family. Instead of being like the clovers, Sweet Clover is more nearly akin to alfalfa, resembling it very closely in appearance, habits of growth, and food content or nutritive value, which, together with their similarity in origin and history, as well as having on the roots the same species of nitrogen-gathering bacteria, would almost lead one to believe that Sweet Clover and alfalfa might be variations descended from what was at one time the same parental species. This seems to be more probable when it is considered that the two had a common habitat in their early history, from Northwest India to the Mediterranean Sea, and that among the numerous species of cultivated and wild alfalfas there are yellow, blue, and perhaps white flowered plants, the same as with the Sweet Clovers.

Sweet Clover is very hardy, makes a rank growth of stems, leaves and roots, but is not persistent, as it may be killed easily by mowing when in bloom. If allowed to mature, it will reseed itself abundantly, even when pastured, and continue like a perennial from year to year, as long as wanted, without sowing again. It thrives in a variety of soils, growing well in almost pure sand, in silt, loam, and hard, rocky and decidedly poor clay soils devoid

of humus. It also grows on hills, bottom lands, in well-drained and in wet soils, and in alkaline and nonalkaline soils. It adapts itself to most all conditions of climate, withstanding the cold winters and hard freezes of our Northwestern States and Canada, the long, hot summers of the South, and the drought of the Western plains. The long, deep taproot enables it to obtain moisture in times of drought, and prevents winter killing, or lifting out with the freezes.

Sweet Clover obtains its name from a strong, distinct, sweetish fragrance of the flowers; also of the plant when drying, which is due to an ethereal oil it possesses, called "cumarin." Sweet Clover is used for hay, pasture and green manure, as well as fertilizing and renovating old, poor and thin soils. The four principal kinds, with their botanical names are: (1) White Sweet Clover (*Melilotus alba*, or *Melilotus altissima*); (2) Biennial Yellow Sweet Clover (*Melilotus officinalis*), (3) Indian, or Annual Yellow Sweet Clover (*Melilotus indica*); and (4) Blue Sweet Clover (*Melilotus caerulea*).

### THE WHITE SWEET CLOVER.

White Sweet Clover, so named from its white flowers, is also called Bokhara, Honey-lotus, Tree Clover and Giant Alfalfa. It is a native of the elevated and arid regions of Asia, and is generally called Bokhara (bō-kä'rä) Clover because it is supposed to have originated in a country of that name in Central Asia, situated just west of Chinese Turkestan and east of the trans-Caspian territory of Russia. This region consists principally of desert and mountain ranges, devoted largely to raising goats, sheep and cattle, and possesses a climate of unusual severity,—of cold in winter and heat and drought in summer. From there it was taken to Persia and Greece, and then to Rome, from whence it spread throughout Europe, where it has been cultivated for hundreds of years as a staple crop for hay, pasture and fertilizer. In America it was known as early as the colonial period, and is now found from Canada to the Gulf of Mexico, and from the Atlantic to the Pacific, flourishing in some parts of every State, in the wild state (as a weed), and in a few localities as a cultivated field crop.

This plant is a biennial, requiring two years to mature and bear seed. The first year it has no bloom, grows erect, and attains a height of three to four feet, though a single plant growing by itself will have a tendency to branch out more. It bears a heavy growth of tri-foliate or three-lobed leaves, resembling alfalfa, and stays green through the fall until hard freezes of the early winter. The second year it comes up from the roots very early in the spring, stooling out at the root crown with usually about ten to twenty, but often more than fifty stalks or stems from the same root. It now bears still heavier foliage of a rich green color, and attains a height of about four feet by the latter part of June. At this period it throws out a number of long lateral branches, and the main stem shoots up to a height of six to ten feet, and is from a quarter to a half-inch thick at the ground. The early part of July the plant reaches full bloom, has lost many of its leaves, and assumes the branch-like appearance that causes it often to be called "Tree Clover." The seed ripens about the first of August, are in close-fitting pods, and are borne on slender racemes three to four inches long. Before branching out preparatory to blooming and seeding a field of Sweet Clover resembles alfalfa so closely that it is often mistaken for alfalfa by those not intimately acquainted with the plant.

The early development of the root system is merely a taproot that reaches well into the subsoil the first two or three months after germination, in search

of food and moisture. Toward the end of the first season the roots acquire an enormous growth and become thick or "fleshy;" sometimes maintaining the original form of a single taproot, but more frequently branching a few inches below the root crown into several large, thick roots, and these support a network of finer roots reaching in every direction. The second year the roots grow some thicker and heavier, and after supporting the season's growth die, and, decaying quickly soon become a part of the soil. Sweet Clover develops the largest root growth of any of the legumes, and is vigorous and prolific in bearing numerous nitrogen nodules.

There is but one species of the White Sweet Clover, though there are different strains. The tame or cultivated Sweet Clover has a more luxuriant growth, is eaten readily by stock, and is otherwise superior to the wild Sweet Clover that is commonly seen growing as a roadside weed.

### **BIENNIAL YELLOW SWEET CLOVER.**

What has already been said applies equally to the Biennial Yellow Sweet Clover, with the exceptions noted herein. The Biennial Yellow is not so generally distributed as the white, as it is grown only in a few States to any extent. Unlike the White, there are many species of the Yellow Sweet Clover, about twenty having been noted in the United States, ranging from low, bunchy, and dwarfish plants, and crawling or vine-like varieties to the tall, erect, and more vigorous kinds that are cultivated as field crops. The farmer will not be interested in any of these but the tall, cultivated variety, except to avoid the others in securing his seed. The Yellow Sweet Clover, having a yellow flower, blooms and ripens its seed about a month earlier than the white. It does not grow so tall or rank as the white, the stems seldom being more than a quarter of an inch thick at the ground, and for this reason is preferred by some who want it for hay only.

### **OTHER SWEET CLOVERS.**

The Annual Yellow, or Indian Sweet Clover, also has yellow flowers, and is supposed to have originated in India. It was accidentally introduced into this country many years ago, probably in hay used as packing material for shipping. It has a limited distribution, but is abundant in the Far West, where it grows wild and is very common in the grain fields. It is a small, slender, dwarfish annual, coming from the seed each year, and growing to about a foot or more in height. It is not economical to raise where the soil will grow any other legume, but it is sometimes used as a cover crop for orchard grounds, and affords some pasture. It is in no sense a cultivated or field crop, and stock are little disposed to eat it on account of its strong odor and bitter taste.

The Blue Sweet Clover, so-called from the color of the blossom, is said to be a native of Northern Africa, and is much cultivated in Europe, particularly in the eastern part; but it is likely that it has the same origin as the white and yellow kinds, and like them, secured a hold in all the countries bordering on the Mediterranean, including Northern Africa. It grows to a height of about three feet, has blue flowers, which are much sought after by bees for honey, and is also used in making perfumes and medicines.

## USES OF SWEET CLOVER.

**Fertilizer.**—The large area of farming lands in the eastern, central, and middle western sections of this country has now been in cultivation for many years, and most of it is beginning to show the drain upon its fertility. Much of the land has become so depleted in plant food as to require continual applications of commercial fertilizers and manures. Millions of acres that were at one time fertile—producing crops that supported numerous families in comfort and affluence—have become so poor as to be unprofitable to cultivate any longer, and no small percentage has been actually abandoned for farm use. Our population is increasing rapidly each year, and our means of supplying their wants are diminishing in even a greater ratio.

The problem of restoring our farming lands, and maintaining them in a state of profitable productiveness has already reached an acute stage. The seriousness and urgency of the situation are not yet fully realized by the mass of farmers of our country, and before the remedy can be applied effectively we will likely be importing a considerable portion of our nation's food supply, while land values will be mounting higher and higher.

It has been well said (and there is comfort in the statement) that there is no such thing as exhausting the soil. The same laws of nature that originally disintegrated the rocks of the earth's crust, and gradually built up a fertile soil, can in time do so again, but this process is slow indeed, and without artificial aid, no material benefit would accrue until after many generations shall have passed. The poorest of our soils contain some elements of plant food, perhaps largely locked up in insoluble forms, and not available; but these conditions can be overcome, and the soil made to respond again to the wants of man. While it is possible to restore these old, worn and depleted lands, the important consideration is the cost. Can it be done economically, so as to pay for the investment,—the capital, labor and material required? Our leaders in agricultural science have pointed out a way that seems practical, namely, the growing of legumes, rotation of crops, and live stock. The object of all three of these is to produce in the soil nitrogen and humus, the two things upon whose subtle alchemy depend more than all else the soil's fertility. The growing of legumes constitutes the foundation of this system of farming, and it is the use of Sweet Clover, as one of the family of legumes, that we are considering as a fertilizer.

Sweet Clover makes a heavier growth of both top and roots than any of the legumes. It is common to see a field in the second year of its growth so tall and dense, when in full bloom, as to be unable to ride through it on horseback, the tops towering above one's head while in the saddle. It has been estimated by a professor at one of our agricultural experiment stations that in a field of Sweet Clover twelve to fourteen inches high, that was plowed under in the spring for corn planting, there were thirty-two tons per acre of green manure that went under in the form of roots, stems and leaves. A full season's growth would have made at least sixty tons or more of green material—certainly enough to renovate and enliven most any soil. While the top growth is very rank, the volume of growth under the ground is still greater. As is characteristic with many biennial plants, Sweet Clover produces, during the first year, very large, thick, and "fleshy" roots, in which are stored up food for starting the succeeding year's crop. After maturing the second season's growth these roots die, and, being "fleshy" instead of hard and fibrous, like the roots of

alfalfa and red clover, they quickly decay and become a part of the soil. The fact that the roots die at the end of every second season makes it a more effective fertilizer than if they lived from year to year like alfalfa.

No other legume will equal Sweet Clover in gathering and storing nitrogen. Not only is it prolific and vigorous in bearing nitrogen nodules on the roots, but the stems, leaves and the roots themselves are all rich in protein (nitrogen), and furnish the soil with a greater amount of this most desirable and costly element of plant food than any other legume. The roots are easily cut with an ordinary plow, and by running a disk over the tops they are cut into small pieces and turned under and mixed with the soil. Thus it is that Sweet Clover furnishes in abundance the two things most needed by the greater number of farms, namely, nitrogen and humus; and by reason of this, together with its ability to grow in all kinds of soil and the convenience in sowing, it excels all other legumes as a practical, efficient and economical fertilizer.

The plant attracted attention here years ago, first as a fertilizer, and for its efficiency in stopping washes on hill lands. It was observed by some of the more alert landowners that Sweet Clover restored fertility to the soil in old, worn, neglected, and even washed fields, in a remarkably short time. More of our farmers began sowing it in a small way, experimenting with it, and discovering new virtues and its adaptability and value to a tobacco-worn and badly washed hill country, and in a few years it came to take a front rank with the farmers as a fertilizer and as a hay, pasture and seed crop. In this county now there are more acres of Sweet Clover than any other clover or grass. It takes hold and grows well in very thin and poor soils where neither grasses, red clover nor alfalfa will start or live. It can be used to restore old fields where other means would be unprofitable, since it can be sown on top of the ground without cultivation or preparation of soil, and with no other expense than the cost of the seed and sowing. When sown in gullies or washes it soon levels them up by catching the soil as it washes down and depositing its own heavy growth.

Sweet Clover has the same species of nitrogen-producing bacteria on its roots as on alfalfa, and much of the seed shipped from here is used to prepare the soil for alfalfa and to provide inoculation. Also the soil from a Sweet Clover field may be used to inoculate for either Sweet Clover or alfalfa. When sown in soils where there has been absolutely no inoculation the development of the plant is slower at first, but before the end of the first season's growth shows a rapidly increasing vigor, and then becomes ranker each succeeding year. In such soils it would be of advantage to inoculate either with soil or with pure bacteria culture prepared in the laboratory, and to be had now at very reasonable prices.

**Pasture.**—Horses, cattle, sheep, hogs and poultry, all feed upon and relish Sweet Clover as they do alfalfa, and it is found by analysis to contain about the same food elements; some analyses showing Sweet Clover the richer food of the two, especially in digestible protein and in fat. Feeding experiments have been conducted with Sweet Clover, the results showing it to be superior to other hay, excepting alfalfa, which gave about the same gain in pounds. The high percentage of fat it contains makes it an ideal forage for milk production and for fattening animals. The fattest lambs and beef cattle shipped from here have been pastured on Sweet Clover. In some localities it is said that stock are slow at first in eating Sweet Clover, but soon acquire a taste for it, and after

that prefer it to any other pasturage. It is quite probable that with the wild strains and the Indian or Annual Yellow Sweet Clover, stock are slow to begin on it, on account of the more pronounced bitter taste noticeable in them, especially toward seeding time, but with us here all kinds of stock eat our cultivated Sweet Clover as readily as any other forage crop grown and often show a decided preference for it.

No other grass will furnish as much pasture or graze as many head per acre, and when the seed is ripe stock fatten on it as they do on grain. One acre of Sweet Clover will furnish as much grazing as 6 acres of our ordinary average pasturage. This last season one of our neighbors kept 10 milch cows on 5 acres of Sweet Clover from early spring throughout the summer, and was able to gather a fair yield of seed, as the cows were unable to keep it grazed down.

As its taproot goes down deep into the subsoil for moisture, it is able to resist severe droughts, and in very dry summers, when other grasses are brown in July and August, Sweet Clover is often the only green thing to be seen in the pasture. It also furnishes the earliest pasture and the very best late fall pasture, resisting ordinary frosts until severe freezes set in.

Unlike alfalfa it will stand close grazing without killing or injury, and will, at the same time, reseed itself, and the tramping of the ground by stock seems to improve the stand and the yield of the crop. There is now a field of Sweet Clover in this county over 20 years old that has alternately been pastured and mowed for hay and seed. The field has now run largely into blue grass, but the two are growing and doing well together.

No case of bloating from Sweet Clover has been noticed here, and it is stated, upon good authority, that the "cumarin" it contains is a preventive against bloating. However, no clover or other rich succulent forage should be allowed cattle in large quantities until they become accustomed to its use gradually, nor should they first be turned in on it when hungry. Sweet Clover does not cause "slobbering" in horses.

The best pastures are those containing mixed grasses and clovers which, maturing at different periods of the year, afford a variety and an abundant grazing, when pastures composed of fewer varieties are brown and bare. The several kinds, having different habits and requirements, seek the food they require at varying levels in the soil, and thus grow and flourish side by side without detriment to each other, and, in fact, are of advantage to each other, as they form a dense sod that chokes out the weeds, and holds the moisture in the soil; and the clovers develop nitrogen on their roots that is immediately available as plant food for the grasses growing with them. By using legumes as a mixture in pastures the grasses may be kept up much longer, and the yield of forage will be much larger and richer. The White Sweet Clover affords more grazing than the yellow, as it grows ranker and stays green later during the second year, when it seeds. Some have observed that where the white and yellow varieties are both grown in the same pasture, stock will feed on the yellow in preference to the white, as long as the former lasts. It may be that because of the finer stems of the yellow, it is relished more by stock than the white variety. The reader should bear in mind that the reference made here to the yellow variety is the cultivated biennial yellow and not the small annual yellow or Indian Sweet Clover, which is often confused with the former.

**Hay.**—If allowed to stand until it blooms, Sweet Clover will soon lose most of its leaves, and the stems rapidly become rather too coarse to handle

easily as hay, but if cut in proper time, the hay is like alfalfa, in texture, and should be cut, cured and handled in the same manner. By the time the seed ripens the plant has shed practically every leaf. It is common to hear Sweet Clover referred to as having "woody" stems when it grows large, but this is not quite accurate. If allowed to grow large the stem is tough and hard while green, but when it dries thoroughly it can easily be pinched off with the thumb-nail and reduced to small pieces in the palm of the hand. The old stems are herbaceous and fibrous, rather than "woody," and when fed as hay, stock clean them up as good as they do the leaves and tips of the plant. Cattle and horses running out during the winter clean up the dry Sweet Clover stems standing bare in the fields or where they have been threshed for seed.

The first year two crops of hay may be cut in this climate, if sown before April, but late sowing will yield ordinarily but one cutting, and that in the fall; the second year one crop of hay and a crop of seed, or two crops of hay—sometimes two crops of hay and a crop of seed. The first year Sweet Clover may be cut for hay most any time that is convenient, and is large enough, but the second year it should be mowed before beginning to bloom and before branching to any extent. The second year, when it comes up in the spring, it stools out from the root crown, but, unlike alfalfa, when cut for hay, it will come on again by branching out from the stem above the ground, consequently it should be cut with a stubble at least 3 or 4 inches high. It requires the same treatment in curing the hay as alfalfa, but is not so easily damaged in the field by showers. The ordinary yield of Sweet Clover hay is from two and a half to six tons per acre, depending upon the stand, soil and season, and whether first or second year's growth. The hay is of excellent quality and relished by all kinds of stock. It has a ready sale where it is known, but owing to its heretofore limited cultivation, there is very little of it to be found upon the market. A professor at one of our agricultural experiment stations, in a recent letter on Sweet Clover hay says: "I planted a little seed two years ago this coming spring, and last year obtained what would be in money value an enormous yield per acre from it—well above \$100."

There is practically no choice between the white and yellow varieties for hay. The yellow, not growing so tall or coarse, has a finer texture and more nearly resembles alfalfa hay than the white variety, and is more easily handled.

While alfalfa hay is rather active on the kidneys and bowels of horses, Sweet Clover has a slightly corrective influence in that regard, and for this reason it is desirable to mix Sweet Clover with alfalfa meadows, resulting in more and better hay as well as assisting the inoculation of the soil where alfalfa is getting a start. On account of the frequent mowings of alfalfa, the Sweet Clover will not be able to reseed, and will disappear from the alfalfa at the end of the second year. Sweet Clover not only makes a very desirable and profitable meadow crop, but also makes a very useful mixture with other meadow grasses and clovers, such as timothy, red top, orchard grass, red clover, mammoth clover, alsike, crimson clover, and no doubt it would be equally good with a number of other grasses that are grown in different sections of the country. As it is not necessary to wait until it blooms or ripens before cutting, it combines handily with most any of the meadow grasses and clovers.

**Honey.**—Sweet Clover produces more honey than any other plant we have. It has been cultivated a long time by the bee men, and here where it is so abundant, there have grown up a number of large apiaries which produce many

tons of honey annually. The yellow variety blooms earlier, and the white comes in at a time when the bees have little else to work on, being after the small white clover, locusts, etc., and before the fall aster. The honey is very clear and of fine flavor.

### SEED AND METHODS OF SOWING.

**Seed.**—There are many kinds of Sweet Clover seed, as there are different kinds of cultivated and wild alfalfa seed. While Sweet Clover grows in every State of the Union, the seed is harvested for the market in only a few localities, principally in some of the Gulf States, in the Far West, in a few counties in Northern Kentucky, and in a small way by a few farmers in some of the States of the Middle West. Only the White Sweet Clover seed is gathered in the Gulf States, and the Far West furnishes the seed of the small Annual Yellow or Indian Sweet Clover. Northern Kentucky produces the greater part of the biennial yellow, and the best grade of the White Sweet Clover Seed, it being the most northern-grown seed that is harvested in any appreciable quantity, and has more vitality, is larger, and germinates better than seed grown in the extreme South.

Owing to its tendency to shatter from the stem, the seed is harvested by cutting the clover by hand with a reap hook when the dew is on, or after a shower; and when dry is beaten out with sticks over a canvas and stored in an airy, sheltered place, to dry thoroughly. In most cases it is then partially cleaned of stems and leaves with a sieve, but there is no uniform method of cleaning, and there being no standard of quality or grading, it is generally put upon the market in a haphazard and indifferent manner, with little care exercised in preserving the vitality or purity of the seed. The seed has a coating, or hull, as is the case with timothy and blue-grass seed, and weighs, according to quality, condition and extent of cleaning, from 20 to 35 pounds to the measured bushel. In harvesting, there will be ripe seed and bloom on the same stalk, and seed in all stages of development; hence, it is important that the seed be well cleaned, and the small, light, and immature seed graded out; otherwise the percentage of germination will be low. The yield of cultivated Sweet Clover seed varies from 300 to 600 pounds per acre.

Not until the last few years has there been much native-grown Sweet Clover seed on the market in this country, the seed having been imported and selling from 30 to 45 cents per pound. Much of the seed now upon the market is either from the wild strains, or from the small Annual Yellow or Indian Sweet Clover, which is saved as a by-product in threshing grain, and is foisted upon the market as "Yellow Sweet Clover," or as just "Sweet Clover." The seed of the white and biennial yellow being very much alike in appearance, only experts are able to distinguish one from the other, and one is sometimes sold by seed merchants under the name of the other. The seed of the Annual Yellow or Indian Sweet Clover found upon the market is always hulled seed.

The first important step in sowing is the selection of good seed, which is, of course, essential to the maximum of success. This involves purity, trueness to name, vitality, vigor, adaptation to the climate, and conditions where sown. Many of the failures in growing alfalfa and clovers might be accounted for by the use of seed from the humid sections for sowing in the arid regions, or seed grown by irrigation and sown where irrigation is not practiced, and by great differences of climate and other conditions. If the Yellow Sweet Clover

is wanted, care should be taken to specify the biennial kind, as the Annual or Indian Sweet Clover will give very little satisfaction, and is not suited to general farming. The latter is often confused with the larger biennial variety and results in disappointment and discourages many in their efforts to grow Sweet Clover. If the white is preferred, the more northern seed should be selected, as it germinates better, is more vigorous and yields more than the wild varieties grown in the South among the Gulf States.

**Methods of Sowing.**—It should be borne in mind that Sweet Clover seed has a very hard seed coat or shell over the germ, which requires plenty of moisture and considerable time to soften to permit germination. This peculiarity exists more or less, with all this class of field seeds, but is more pronounced with Sweet Clover. It is attributed by some, who are unfamiliar with it, to a lack of vitality in the seed, but such is not the case, as tests made under the sulphuric acid treatment, or with "scratched" seed, promptly show that between 95 and 98 per cent. of the seed in this locality is vital and germinates well, and many tests show one hundred per cent. vitality. In tests conducted at agricultural experiment stations these methods are frequently resorted to in order to facilitate the entrance of moisture to the germ, thereby promoting a prompt germination. The acid treatment cuts off part of the hard coating or shell over the germ and makes it thinner, and "scratching" the seed is done with a knife or file, making an opening in the shell for the entrance of moisture. If sown in late spring, followed by dry, cool weather, the seed, or most of them, will lie dormant in the ground until the next spring, and then come up and make a good stand. By our method here in Northern Kentucky, of sowing during the winter months or early spring, we entirely avoid this difficulty. The rains and freezes and thaws cover the seed to just about the right depth, and the shell becomes thoroughly saturated and softened, permitting complete germination with the advent of warm weather in the spring, and it is only in rare instances that we have any difficulty with the germination, if the seed is good. Summer sowing, in July and August, also results in good germination, because the heat quickens the action of the moisture in the soil in softening the shell or seed coating. For late spring sowing it is very beneficial to run a roller over the ground after sowing, so as to bring the soil particles in contact with the seed, and bring up the moisture from the subsoil by capillarity. The writer has made numerous comparative tests with hulled and unhulled seed to ascertain which gives the best germination. With winter, early spring, and summer sowing no difference was noticeable, either in promptness or percentage of germination, but with late spring sowing the hulled seed made a little better showing, both in percentage and promptness of results. The hull consists of a very thin, fragile and porous membrane, covering the seed, and it should be kept in mind that it is the hard seed coat or shell underneath the hull that is so impervious to moisture and not the hull. With sufficient moisture the hull might aid germination by holding a filament of water around the seed. The practice in Northern Kentucky has been to sow the unhulled seed altogether.

There are two principal methods of sowing: First, sowing broadcast on top of the ground without covering; and second, sowing or drilling with cultivation or preparation of the soil and covering of the seed. The two methods will be considered separately.

Sowing by the first method can be done from late in the fall to early spring, the earlier the better, thus giving ample time to saturate and soften the hard

seed coating over the germ and pave the way for a complete germination with the advent of warm weather. This method of seeding has the advantage of convenience, since it can be done most any time within a period of several months, and also of economy, as there is no expense or labor required in plowing, harrowing, etc., and permits the use and occupation of rough, poor lands, for Sweet Clover that either could not be plowed, or would not be profitable to seed if they had to be plowed and cultivated. This method is also used in sowing Sweet Clover with wheat, rye, winter oats, and sowing with other grasses in meadows and pastures.

The months of December, January, February and March, are the best for sowing broadcast without covering, and this is when most of the sowing is done in Northern Kentucky, where Sweet Clover has demonstrated its great worth and possibilities. November is too early here, as the seed may germinate before winter and the young plants be killed by the hard freezes immediately following; and March is late enough in the spring to allow the seed to become covered by rains and alternate freezes and thaws. In light, sandy soils, that are well drained, the surface is not much disturbed by freezes and thaws, and in such cases it would be advisable to stir the soil lightly with the harrow to cover the seed.

By the second method the first sowing will likely be with spring oats or barley, when Sweet Clover may be sown and covered lightly with them; or sown afterwards and covered with a drag or harrow. But a much better time is in April or May (according to the season), with a seed bed made fine by tillage, the seed sown and covered lightly, and the ground firmed with a drag or, preferably a roller. This is an ideal time and manner of sowing alfalfa and applies well to Sweet Clover. Some prefer the late summer or fall sowing, from July to September, which has the advantage that two full crops of clover can be cut the next year, thus gaining practically one whole season in maturing the plant; it also allows opportunity for frequent tillage of the soil during the early summer to destroy weeds, but it should be sown in time to get a start before the hard freezes of the winter set in and catch it while it is germinating or just coming up.

Another method is to sow with corn at the last cultivation, which is highly recommended by practical agriculturists, and is much practiced in some parts of the country. It is also sown in the fall with wheat and rye. As the clover should not be covered as deeply as the grain it is best to sow just after, and cover with a drag, harrow or roller. The roller will very materially help the grain in making a start.

**Amount of Seed.**—The amount of seed required per acre depends upon whether sown for hay, pasture, green manure, or for restoring worn or waste idle lands. On account of its stooling so heavily, a medium stand the first year will become a thick stand the second, when it comes from the roots; and a heavy stand the first year will be entirely too thick the second year to obtain a normal growth and development of the plant. For hay, a bushel will sow 3 acres; for green manure, a bushel will sow 2 acres, if to be plowed under the first year, and 3 acres, if to be plowed under after the second year's growth. Too thick a stand will result in excess of stems, while with a medium stand the plants will branch out better and produce more foliage, and consequently better hay, and just as much green manure.

In sowing for pasture the amount of seed depends upon the amount of other seed forming the mixture to be sown, or the stand of grass already growing.

All good pastures ought to have not less than two or three kinds of clover and three or four kinds of grasses—the more the better. One bushel of Sweet Clover seed to 6 acres, for pasture containing a fair stand of other grasses, is recommended; and the same amount for mixing with timothy, alfalfa and red top meadows. One bushel of seed to 6 acres is recommended for sowing on waste and idle lands for restoring them to fertility and stopping and filling washes and gullies. A well-developed plant will bear from 1,000 to 2,000 seed, and it does not take long to spread over a field after once seeded, but while it seeds rapidly it is advisable and economical to sow enough seed at the start to secure a good stand.

Being a biennial it is a good plan to sow Sweet Clover in a field, both the first and second years, thereby having a continuous pasture and hay crop. By this means a good cutting of hay may be obtained in the spring, and then a seed crop or another cutting of hay by the middle or latter part of summer. After harvesting the seed crop (or second cutting of hay), the young seedling plants will come on rapidly and make a good cutting of hay in the fall, thus making three crops each year. It will bring pleasing results if some seed are scattered about in waste places, in washes and on rocky or poor points, where it will grow and rapidly bring about a great change in the condition and fertility of the soil.

**Nurse Crop.**—While the supposed object of a “nurse” crop is to shelter and protect the young plants while tender, yet, as practiced in most instances, it is used for the purpose of getting a crop of grain while waiting for the young clover to come on. It is reasonably certain that the nurse crop is of no advantage, as it robs the young plants of moisture, light and food, which often proves fatal to the clover. The better practice with Sweet Clover is to sow alone, but if a nurse crop is used, rye and spring barley are the best to sow with, as they shade the ground the least; wheat, and especially oats, shade the ground the most. Some sow about a quart of rye to the acre with clovers and alfalfa, which comes up and affords some shelter for the young plants from the cold winds in the spring, and from the hot rays of the sun in the summer; but these advantages are more theoretical than certain.

**Inoculation.**—The principal advantage of legumes over the ordinary forage crops is in their ability to obtain free nitrogen from the air, and store it in the stems, leaves and roots. This is done by means of bacteria in the soil that develop on the roots. These bacteria are minute plants that grow and multiply with wonderful rapidity when the conditions are suitable for their development. They increase by dividing, and each one in turn becomes the forerunner of many more. It is stated that they increase every fifteen to twenty minutes, when conditions are favorable, and thus it will be seen that in twenty-four hours many millions of them may result from a single ancestor. In fact, the number that will develop is limited only by the chemical condition of the soil and the amount of vegetable matter or humus, as food material, that it contains. These bacteria develop nitrogen best in soils that are alkaline, or at least neutral. While acidity is generally detrimental to bacteria, it is not certain that any chemical action or non-action would prevent the nitrogen-fixing bacteria from performing their normal function in acid soils. But for the nitrifying bacteria to produce nitrification, it is necessary to have some easily available base, such as the calcium in limestone, and that does not exist in acid soils. Acid soils may be rendered neutral or alkaline by the application of lime, in the form of burned lime, ground limestone, etc.

There seem to be different species of these bacteria, one applicable to alfalfa, Sweet Clover and burr clover; another kind for red clover and others; another for beans, etc. A field may be inoculated for Sweet Clover in either of two ways: (1) By obtaining soil from a field of Sweet Clover, alfalfa or burr clover, where bacteria are shown to be present by nodules on the roots of the growing plants, and (2) by the use of pure bacteria culture, bred in a laboratory and put up in suitable and convenient sized packages ready for application to the seed when sown. Inoculated soil obtained in the neighborhood, from a field free from noxious weeds, is to be preferred, and about 300 pounds per acre should be used; otherwise, pure bacteria culture will be cheaper and, besides, has some advantages over the soil method, since with the latter there is liability of obtaining noxious weeds and fungus soil diseases, and by distributing 300 pounds of soil over an acre by the most careful spreading, many spots will receive no bacteria, while with the pure culture it is applied direct to the seed, and every plant will receive inoculation.

The bacteria are not affected by freezing, but should not be exposed to strong sunlight. The application should be made late in the afternoon or on a cloudy day and followed soon after with the harrow or disk. For winter or early spring sowing the bacteria may be mixed with the seed and sown broadcast on top of the ground, when it will become covered gradually with the seed, the rays of the sun at this time of the year not being strong enough to affect it.

In soils containing sufficient nitrogen, legumes will grow without these bacteria, but in that case no nitrogen is added, and the crop draws upon the soil for its supply of this most valuable and costly element of plant food, instead of obtaining it from the air. With soils deficient in nitrogen—and that applies to many soils—legumes without these bacteria will make but a very poor growth, and live but a short time. It is by the aid of these friendly little bacteria that poor soils become richer, and are made to yield the rich forage common to the legumes.

The writer and his neighbors have grown Sweet Clover successfully for years without inoculation, and here, as in other places, it is commonly believed that Sweet Clover will inoculate itself. We are inclined to believe that inoculation spreads here from one section of the country to another, first along the roadsides, and then from field to field by particles of soil being carried by the wind. Another explanation is the fact that we have always sown the unhulled seed, and the rough surface of the pods more than likely carry small particles of soil from the field where it was grown—enough to give the microscopic bacteria a start. However, whether it inoculates spontaneously, or is inoculated artificially, the inoculation is very essential to the best success with Sweet Clover, and this is more important in securing good results than the fertility or the character of the soil.

**Lime.**—The frequent recommendation of the use of lime on the farm has, perhaps, led to some confusion as to its functions. While it is one of the essential elements constituting plant food, yet the amount required by most plants is so very small that there are few soils in which lime is lacking to the extent that any additional supply is needed for that purpose. There are three ways in which lime may be very beneficial: First, in decomposing stored mineral substances, especially potash, and rendering that element and phosphorous more available as plant food; and in decomposing organic matter, which is the source of much of the nitrogen content of the soil. In this way lime

acts as a stimulus, rather than adding new material as plant food. Second, by improving the mechanical condition of the soil, making it mellow and more responsive to the influences of soil water, and air. These beneficial effects are particularly noticeable in heavy or clay soils. Third, by correcting an excess of acidity in the soil, and rendering conditions favorable for the work of nitrogen-gathering bacteria. Clovers and alfalfa utilize somewhat more lime as plant food than other forage crops, but the assertion often made that they are "lime-loving" plants should be taken more appropriately to mean that the lime improves the chemical and mechanical condition of the soil and renders it more suitable for the work of nitrogen-fixing bacteria, thus promoting healthy growth of these plants by developing the requisite nitrogen. Sweet Clover is benefited by lime in the soil, but is not so dependent upon it, as it grows well in soils that are neutral, and "produces satisfactory crops on the 'acid soils' of the Eastern States."\*

The principal sources of lime for agricultural uses are burned lime and ground limestone. The amount of burned lime to be used varies from 200 to 500 pounds per acre for light, sandy soils, to 2,000 pounds or over for heavy clays. The amount of ground limestone should be double that of burned lime, as it is dissolved and becomes available more slowly, but for the same reasons its beneficial effects last much longer.

## CONCLUSION.

While endeavoring to arrive at a fair estimate of the value and merits of Sweet Clover on the farm, one is likely to encounter differences of opinion, for some may have expected too much from it and are disappointed, a few have tried once and failed to get it to grow, and others having had more or less success become over-enthusiastic in praise of its merits. The truth is, we have no one plant that fulfills all the requirements of an ideal forage crop. The greatest one is, perhaps, alfalfa, but it is a rather particular chooser of soils and climates, requires special tillage and inoculation and then is uncertain. It will not stand close pasturing, and has numerous insect enemies.

Strangely enough, in the onward march of our great agricultural development, there has been little attention given to alfalfa's first cousin, Sweet Clover, and consequently there is really but little known about it among farmers generally. That it is rich in food value, grows luxuriantly, stands grazing without injury, and thrives in a great variety of soils and climates; that it inoculates readily and has no insect enemies, are enough to make it all but the greatest of leguminous forage crops, certainly next to alfalfa; and in some localities and soils where alfalfa will not succeed, there Sweet Clover will have no superior. As it becomes better known, it will come to have a prominent place in our agriculture, in feeding, rotation, and soil renovation; and as stock raising and dairying increase its place will become more and more prominent.

Some of us little realize the importance of our forage plants, and think that the plow and the hoe only are producers of values on the farm. The truth is that our forage plants are of more value than any of the cereals—corn, wheat, rye, oats, rice, etc. The profits from beef, pork, mutton, the dairy, and from poultry, all

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\* Farmers' Bulletin No. 485.

come from the pasture rather than from the corn crib or the granary. If our forage plants dried up or failed for but one season, there would be left us scarcely a single domestic animal surviving.

Truly the gift of the green herbage, spreading out under our feet in its beauty and freshness, to adorn the earth and provide sustenance for man and beast, is the greatest and best boon of Providence. This was the foundation of the first primitive agriculture, and is now the dependence, the hope, and profit of our best farming.

#### APPENDIX.

The following analyses were made by the Wyoming Experiment Station of Sweet Clover and alfalfa grown on the experimental farm, and published in Wyoming Bulletin No. 70, pages 70 and 74. These analyses show Sweet Clover to be richer than alfalfa in protein (muscle, bone and tissue material), and in ether extract, or fat-forming substance.

	SWEET CLOVER		ALFALFA
	Cut Oct. 4, 1904.	Cut Aug. 10, 1905.	Average of 11 Samples.
Water	6.02	6.88	6.57
Ash	9.57	11.03	8.79
Ether extract	2.42	1.96	1.66
Crude fibre	21.77	22.27	31.25
Crude protein	18.00	22.19	15.14
Nitrogen Free Extract	42.22	35.67	36.59

It is shown by experiments at the College of Agriculture, Cornell University, Ithaca, N. Y., that grasses grown with legumes, such as clovers, etc., contain more protein, and consequently are of more economical value, than when grown alone. It would seem that while they are both growing together, the grasses receive directly from the roots of the legumes a large supply of available nitrogen which makes, not only more feed, but richer in feeding values.

The following table is taken from Cornell Bulletin No. 294:

Crop.	Protein in Dry Matter.	Protein Per Ton of Hay (10% moisture).
		Per Cent.
Timothy grown alone	17.19	309
Timothy grown with clover	24.56	442

Those desiring to investigate further the subject of Sweet Clover, will find the following publications of interest and value:

Farmers' Bulletins, Nos. 485 and 278; Circular No. 80, Bureau Plant Industry; Circular No. 129, Ohio Experiment Station; Bulletin No. 70, Wyoming Experiment Station; and "The Truth About Sweet Clover," The A. I. Root Co., Medina, Ohio.